ADDITIONAL OBSERVATIONS ON PLUMATELLA REPENS (L.) (A FRESH-WATER BRYOZOAN) V. RE-CONSIDERATION ON THE RELATIONSHIP BETWEEN P. REPENS AND P. FUNGOSA BY THE REARING

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ADDITIONAL OBSERVATIONS ON *PLUMATELLA REPENS* (L.) (A FRESH-WATER BRYOZOAN)

V. RE-CONSIDERATION ON THE RELATIONSHIP BETWEEN *P. REPENS* AND *P. FUNGOSA* BY THE REARING[1)]

By

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INTRODUCTION

In the previous report, the writer stated that he failed to find any specific difference between the two species, *P. repens* and *P. fungosa*, from the field materials re-examined, because they were connected by many transitional forms. The zoarial mass of *P. fungosa* originated from many statoblasts, while those of *P. repens* from one or a few statoblasts. And, moreover, the materials of the two species re-examined were from different localities. It seemed, therefore, that the two species may not show the true differences by this procedure of comparison.

To clarify the relationship of the two species, comparison should be made on the materials grown under the same condition. Hence, the writer made some rearing observations on the two species from 1957 in the laboratory. The results obtained are given in this paper.

Before proceeding further, the writer would like to express his hearty thanks to Dr. Fritz Wiebach, Plön, Germany and also to Dr. Erich Rüsche, Neukirchen/Vluyn, Germany for their kindness in sending the valuable materials of *P. fungosa* to the present writer. Acknowledgements are also due to Dr. Zen-ichiro Hoshino, Marine Biological Station, Tôhoku University, for his kind assistance during this study.

REARING OBSERVATION ON THE GERMAN *P. FUNGOSA*

Many workers hitherto emphasized that the most important character of *P. fungosa* is the speciality of the zoarial mass. To show the speciality of the zoarial mass of *P. fungosa*, those of the two species, *P. repens* and *P. fungosa*, originated from the same number of statoblasts should be compared with each other. At least

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one colony of *P. fungosa* should be compared with one of *P. repens*. But it seems that the actual observations on a single colony of *P. fungosa* are few in number. To ascertain the appearance of the colony, an observation was first made in 1957.

Observation 1

Material. One zoarial mass of *P. fungosa* received from Dr. Wiebach
Method. Some floatoblasts were taken from the material. The rearing procedure was similar to that in the previous reports.
Results. One month after the germination of the floatoblasts, the colonies became large, and the polypides degenerated gradually. Each mature colony was entirely repent and widely open in branching as shown in Pl. XI, fig. 1. They beared a close resemblance to some field materials of the Japanese *P. repens* and the specimens from Belgium especially to the latter in the appearance of the colony.

From this result, it may be said that:

(1) Each colony originated from one floatoblast of *P. fungosa* is repent entirely and widely open in branching on a flat substratum.
(2) These colonies bear a close resemblance to those of *P. repens*.

In this observation, the writer planned to compare *P. fungosa* with the Japanese *P. repens* from the reservoir at Asamushi, but the floatoblasts of the latter did not germinate at that time. The writer failed to rear the material of *P. fungosa* throughout successive generations in this observation.

COMPARISON OF THE PLUMATELLAS UNDER THE SAME CONDITION

It became clear that one colony of *P. fungosa* bears a close resemblance to that of *P. repens* in the appearance of the colony. To analyse the relationship of the two species, they were reared at the same time together with some Plumatellas from the Sendai area.

Observation 2

Materials. (a) The statoblasts of *P. fungosa* of the third generation received from Dr. Rüsche
(b) The statoblasts of the Plumatellas from the Sendai area
Method. It was similar to that reported in the previous papers. One month after the germination of the statoblasts, the colonies were examined.
Result. (a) Colony In this rearing condition, the colonies of *P. fruticosa* and *P. casmiana* were small in extension especially in the latter. It seemed that this rearing condition was unfavorable to these species (Pl. XII, figs. 4, 6).

In *P. fruticosa*, all the zooecial tips bent upwards and the branching of the colony was sparse. At the central part of the colony a few free branches of two or three zooecia were seen. The colony had a peculiar appearance and could be distinguished from the others at a glance (Pl. XII, fig. 4).

The colonies of *P. emarginata* were widely open in branching and showed the largest extension among the Plumatellas with long zooecia. One colony had some irregular free branches at the central part. The colonies of *P. vorstmani* were most widely open in branching with linear and slender zooecial tubes (Pl. XII, fig. 5). Extension of the colony was next to that of *P. emarginata*. In *P. casmiana*, the colonies were smallest in extension and most compact in appearance among the Plumatellas with short zooecial tubes. The colonies of *P. fungosa* were widely open in branching but more compact and of less extension than those of *P. emarginata*. They beared a close resemblance to those of *P. repens* from Morigô near Sendai City and the reservoir, Aomori No. 3, in the appearance of the colonies. It was very difficult to distinguish the colonies of *P. repens* and *P. fungosa* from each other in the appearance of the colonies, but the other Plumatellas could be distinguished from one another at a glance (Pls. XII, XIII, figs. 3–8).

(b) Thickness of the ectocyst

The relation among the Plumatellas in ratio of thickness of the ectocyst to width of the zooecial tube agreed with that reported in 1956 (Toriumi D). In the thickness of the ectocyst, the two species, *P. repens* and *P. fungosa* could not be distinguished from each other.

(c) Structure of the ectocyst

Except for *P. vorstmani*, the reared Plumatellas have a hard chitinous layer at the inner side of the ectocyst just as the field materials (Toriumi 1956 D). In *P. fruticosa*, the hard chitinous layer is thickest among the Plumatellas reared. The hard chitinous layer of *P. emarginata* is thinner than that of *P. fruticosa*. That of *P. casmiana* is thinner than that of *P. emarginata*. In *P. repens* and *P. fungosa* this chitinous layer is slightly present or absent. In this respect, these two species show no difference from each other (Pl. XVIII, figs. 37–42).

(d) Coloration of the ectocyst

Among the immature colonies of the Plumatellas, in which the polypides were 5–20 in number, the ectocyst was pale yellowish gray in color in *P. fruticosa*, of clear reddish brown color in *P. emarginata* from the Morigô, and in the materials of the same species from Yohee-numa and Kaidô-numa, it was pale brown—dark brown in color. The difference of coloration among the intraspecific groups was seen only in *P. emarginata* in this rearing observation. The ectocyst of *P. casmiana* was of pale brownish color. In *P. vorstmani*, *repens* and *fungosa*, the ectocyst was colorless and transparent.

One month after the germination of the statoblasts, the ectocyst of the mature colonies of *P. fruticosa* was of darker color than that of the immature colonies. In *P. emarginata*, the ectocyst became blackish brown in color, and in *P. casmiana* of grayish brown tint. The ectocysts of *P. repens* and *P. fungosa* in the greater part of the colonies was of pale yellowish gray hue but almost transparent. In

P. vorstmani, the ectocyst was colorless and hyaline. In the coloration of the ectocyst, *P. repens* and *P. fungosa* could not be distinguished from each other.

(e) Encrustation

The ectocyst of *P. vorstmani* was naked with no encrustation. In *P. fruticosa*, the ectocyst was most densely encrusted followed by *P. emarginata* and *P. casmiana* among the Plumatellas. In *P. repens* and *P. fungosa*, encrustation was slight but almost naked. No difference was seen between the two species in this feature.

(f) Width of the zooecia

As seen in the figures, the most slender zooecial tubes are those of *P. vorstmani* and those of *P. fruticosa* follow them in width. In *P. repens* and *P. fungosa* the zooecial tubes are thickest among those of the Plumatellas, and no difference is seen between *P. repens* and *P. fungosa* in width of the zooecia.

(g) Tentacle number

As in the case of the field materials, the tentacle number is smallest in *P. vorstmani* and largest in *P. fruticosa*. Between *P. fungosa* and *P. repens* from Morigô, no difference was recognized in the tentacle number.

(h) Statoblasts

Remarkable difference among the Plumatellas was seen in shape and dimension of the statoblasts. Besides these features, the ornamentation of the capsule showed specific difference among the Plumatellas as in the case of the field materials. But between *P. fungosa* and *P. repens* from the Sendai area, a little difference was recognized in the measurements. The statoblasts of *P. fungosa* were slightly larger than those of *P. repens* in length and width, but they agreed with those of *P. repens* from Shige-numa in the measurements and in the other features of the statoblasts. In the said features, *P. fungosa* could not be distinguished from *P. repens* (Pl. XVIII, figs. 43–46).

(i) Formation of the statoblasts

In *P. fruticosa* and *P. casmiana*, a few statoblasts were formed during rearing. The mature floatoblasts of *P. vorstmani* were released from the zooecia one after another, and thus, the mature floatoblasts were scarcely seen in the zooecia. In *P. emarginata*, the formation of the statoblasts was later than that of *P. repens* and *P. fungosa*. In the latter two species, the formation of the statoblasts was relatively earlier than the others and the mature floatoblasts were present for a long time in the zooecia. In this respect, *P. repens* and *P. fungosa* showed no difference from each other.

Thus the Plumatellas showed marked difference in all the features observed, but no essential difference was recognized between *P. repens* and *P. fungosa* under the same condition.

COMPARISON OF THE TWO SPECIES THROUGHOUT THE SUCCESSIVE GENERATIONS

The comparison between *P. fungosa* and *P. repens* in Observation 2 was made once during one generation. As the next step of study, the comparison of *P. fungosa* with some intraspecific groups of *P. repens* was made under the same condition from 1968 to 1970.

Observation 3

Materials. (a) The material of *P. fungosa* received from Dr. Rüsche
(b) The materials of *P. repens* from Tsuta-numa, Shige-numa, Yohee-numa and the two reservoirs at Morigô and at Asamushi

Method. Similar to that described in the previous reports

Result. (a) Colony

(i) In the first generation, two immature colonies of *P. fungosa*, in which their ancestrulae were put in a touch with each other at first, formed a compact but flat mass (Pl. XV, fig. 13). This flat mass resembles the parent zoarial mass of *P. fungosa* in compactness but differs from it in thickness. (ii) In some immature colonies of *P. fungosa*, the central part of the colony was compact but the peripheral part was open in branching (Pl. XV, fig. 14). Compact colonies as these were not seen in Observation 1. Although the branches of the peripheral part were open in branching, these branhes were more compact than those of *P. repens* reared at the same time. (iii) The remaining immature colonies of *P. fungosa* were open in branching but they were more compact than those of the intraspecific groups of *P. repens*. They became more widely open in branching with growth and the majority of the mature colonies were identical to those in Observation 1.

In the second generation of *P. fungosa*, the colonies originated from the statoblasts of (ii) and (iii) showed no difference among them in compactness. The immature colonies originated from the floatoblasts and the sessoblasts showed no difference between and they were widely open in branching but more compact than those of *P. repens*. The mature colonies of *P. fungosa* could not be distinguished from the colonies of the Belgian *P. repens* which were received from Professor Brien in 1954, in the appearance of the colony, budding frequency, mode of branching, width and length of zooecia, winding of zooecial tube, structure of ectocyst and degree of encrustation etc.. They beared a close resemblance to those of *P. repens* from Shige-numa and Tsuta-numa in the appearance of the colony. Some mature colonies of *P. fungosa* were more widely open in branching than the others and they could not be distinguished from the colonies of *P. repens* from the reservoir at Morigô.

In the third generation, the mature colonies of *P. fungosa* originated from the floatoblasts agreed with the colonies of *P. repens* from Yohee-numa and the reservoir at Morigô in the appearance of the colonies. The material from

Asamushi was more widely open in branching in comparison with that of *P. fungosa* and the zooecial tubes were slender. Thus these two materials showed a little difference in the appearance of the colony.

One additional observation was made using the aged colonies of the third generation of *P. fungosa* and *P. repens* from Asamushi. Some branches at the peripheral part of the aged colonies were cut off and transferred to separate new dishes. They were reared under the same condition. One month later, the newly formed colonies were examined. The newly formed colonies of *P. fungosa* were widely open in branching with slender zooecia and they agreed with those of *P. repens* from Asamushi in the appearance of the colonies, mode of branching and in the budding frequency. In these materials, the two species could not be distinguished from each other. This proves that the appearance of the colony varies markedly being influenced by environmental condition.

In the 11th generation, all the mature colonies of *P. fungosa* originated from the floatoblasts and the sessoblasts were widely open in branching and they could not be distinguished from the colonies of *P. repens* from Shige-numa, Yohee-numa and Morigô. The compact colonies of *P. fungosa* seen in the first and the second generations were not formed since the third generation (Pl. XI, fig. 2).

In very young colonies of the 11th generation of *P. fungosa*, it seemed that the budding frequency was more or less higher than that of *P. repens*. With the growth of the colony, this difference became obscure and finally the mature colonies of the two species showed no difference in the appearance of the colony. Judging from the difference of the budding frequency among the intraspecific groups of *P. repens* (Toriumi 1970 A) it is very difficult to regard the difference of the budding frequency in very young colonies as specific difference.

Thus, no essential difference was recognized between the two species in the appearance of the colonies reared under the same condition.

(b) Growth pattern

As already mentioned, it was very difficult to distinguish the aged colonies of *P. fungosa* and *P. repens* from each other. Between the young colonies of the two species, which had 5–6 polypides, it seemed that a little difference was seen in mode of budding as shown in Plate XVII, figs. 21~30. But such difference as this is also seen among the intraspecific groups of *P. repens*. From this fact, it cannot be said that the growth pattern of *P. fungosa* differs from that of *P. repens*. Difference of the growth pattern between the two species emphasized by some workers is caused by the environmental factors especially by the number of the statoblasts from which the zoarial mass originated and by the nutrition.

(c) Thickness and structure of the ectocyst

No difference was seen in these features throughout the successive generations.

(d) Other features of the ectocyst

No difference was recognized between the two species in any feature of stickiness, toughness, elasticity, transparency and coloration. When the ectocyst of *P. fungosa* became stiff and tough at the aged part, that of *P. repens* was similar at the aged part.

(e) Width of the zooecia

In the first generation of *P. fungosa*, the zooecia of the immature colonies were relatively thick, but with the growth of the colony, the newly formed zooecia decreased in width as shown in Plate XVIII, figs. 31, 32. In this period, the width of the zooecia of *P. fungosa* agreed with that of the materials of *P. repens* from Tsuta-numa and Shige-numa. In the third generation of *P. fungosa*, the width of those in mature colonies agreed with that of the materials of *P. repens* from Yohee-numa and the reservoir at Morigô. The width of the newly formed colonies from the aged *P. fungosa* mentioned above agreed with that of the material from Asamushi. It may be said that no specific difference is seen between the two species grown under the same condition (Pl. XVIII, figs. 31–36).

(f) Winding of the zooecial tubes

The zooecial tubes of *P. fungosa* were not straight and marked winding was seen in Observation 1. This winding of the tubes is less marked in *P. fungosa* in Observations 2 and 3. In the materials of *P. fungosa* in the 11th generation, this winding was obscurely seen. Such winding as this is also seen in the material of *P. repens* from Aomori No. 3, but in the other materials of *P. repens*, this winding of the tubes was obscurely present or absent (Pl. XVII, figs. 17–20).

On February 21st, 1969, one intraspecific group of *P. repens* from Morigô showed marked winding of the tubes, and this material could not be distinguished from the third generation of *P. fungosa*, which was reared together with this material of *P. repens*, in all the features of the colony and the zooecial tube.

From these facts, it may be said that the winding of the zooecial tubes is not a specific character of *P. fungosa*.

(g) Tentacle number

P. fungosa showed no difference from the material of *P. repens* from Yohee-numa and the reservoir at Morigô, but differed from those from Tsuta-numa and Shige-numa in tentacle number as shown in Table 1. From this result, it cannot be said that *P. fungosa* differed from *P. repens* in tentacle number.

(h) Measurements of the statoblasts

Among the materials shown in Table 1, *P. repens* from Shige-numa showed no difference from *P. fungosa* in the measurements of the floatoblasts. These two materials were compared with each other throughout the period from 1969 to 1970 under the same condition. The two materials showed no difference in any case. For example, the materials examined on September 15th, 1969 are shown in Table 2.

Table 1
Comparison of *P. repens* and *P. fungosa* September 3rd, 1969

	Groups	Tentacles		Measurements of floatoblasts			
		mean	number of readings	length (mean)	width (mean)	ratio length/width	number of readings
P. repens	Morigô SF	46.4	30	0.359	0.277	1.27	54
	Tsuta-numa	60.2	30	0.404	0.292	1.38	57
	Shige-numa	59.6	30	0.419	0.303	1.38	65
P. fungosa		46.7	30	0.424	0.294	1.43	54

P. fungosa agrees with *P. repens* from Morigô in tentacle number but differs from it in measurements of the floatoblasts. No difference is seen between *P. fungosa* and *P. repens* from Shige-numa in measurements of the floatoblasts.

Table 2
Comparison of *P. repens* and *P. fungosa* September 15th, 1969

	Measurements of floatoblasts			
	length (mean)	width (mean)	ratio length/width	number of readings
No. 1				
P. repens Tsuta-numa	0.392	0.282	1.39	23
Shige-numa	0.413	0.290	1.42	55
P. fungosa	0.416	0.289	1.43	67
No. 2				
P. repens Tsuta-numa	0.399	0.290	1.37	68
Shige-numa	0.418	0.303	1.37	68
P. fungosa	0.421	0.304	1.38	60

The materials in No. 1 were reared at 28°C in a small vessel and the others at 23°C in a large vessel. Between *P. fungosa* and *P. repens* from Shige-numa, no difference is seen in the measurements.

In *P. repens*, the measurements of the floatoblasts vary at different temperatures (Toriumi 1970 C). The same phenomenon was recognized in *P. fungosa* reared at 28°C, 23°C and 13°C. As seen in Table 3, the floatoblasts of *P. fungosa* are most elongated at 28°C and most rounded at 13°C. Many circular floatoblasts were formed at 13°C. In the mode of variation of the shape at different temperatures no difference was recognized between the two species. In this respect, *P. fungosa* cannot be separated from *P. repens*.

As already stated in the previous report, the length of the floatoblasts in mean was largest at 28°C and smallest at 13°C in *P. repens*. The same result was obtained in *P. fungosa* as shown in Table 3. In these observations, the length and the shape, which is represented by the ratio of length to width, varied in parallel with each other.

Table 3
Variation of the floatoblasts of *P. fungosa* in measurements at different temperatures
April 14th, 1969

Temperature reared	Length (mean)	Width (mean)	Ratio L/W	Number of readings
28°C	0.412	0.292	1.41	72
23°C	0.392	0.293	1.33	56
13°C	0.377	0.324	1.16	58

At 28°C, the length and the ratio are largest but the width smallest.

Table 4
Variation of the floatoblasts in measurements at the same temperature (23°C)

	Date examined	Length (mean)	Width (mean)	Ratio L/W	Number of readings
P. repens (Shige-numa)	Sept. 15, '69	0.401	0.297	1.34	68
	Apr. 15, '70	0.419	0.312	1.34	54
P. fungosa	Nov. 7, '68	0.393	0.289	1.35	33
	Apr. 1, '70	0.417	0.307	1.35	44

Difference is insignificant in shape, but is significant (significant level 0.05) in length and width.

As to how the length and the shape vary at the same temperature was observed throughout a long period at 23°C. Even at the same temperature, difference was recognized among the materials of each species in length (Table 4). In these materials, the largest and the smallest sized floatoblasts in which the shape was similar to one another were:-

		Length (mm)	Width (mm)	Ratio length/width
P. repens from Shige-numa	smallest	0.39	0.29	1.34
	largest	0.43	0.32	1.34
P. fungosa	smallest	0.35	0.26	1.35
	largest	0.44	0.32	1.35

From these facts, it may be said that (1) the largeness of the floatoblasts, which is represented by length and width, varies but not parallel with the shape, and, (2) the variation range of the shape is relatively narrow but the size varies in a wide range even at the same temperature. Concerning the variation of the largeness, the two species show no difference from each other.

Thus the two species cannot be distinguished from each other in the measurements and in the mode of variation of the statoblasts.

(i) Ornamentation of the capsule

Reticulation and tuberculation of the capsule of the floatoblasts are seen in all the materials of *P. fungosa* and *P. repens*. In this concern, *P. fungosa* cannot be distinguished from *P. repens*.

As mentioned above, the German *P. fungosa* reared in the laboratory could not be separated from the intraspecific groups of *P. repens* in any of the features.

CONSIDERATION ON *P. FUNGOSA*

As stated in the previous report, *P. repens* and *P. fungosa* were distinguished from each other mainly by the appearance of the zoarial mass, growth pattern and measurements of the statoblasts. But these features are easily changeable being influenced by the environmental factors as shown in the present paper. The appearance of the zoarial mass is decided by the number of the statoblasts, from which the zoaria originated, and the budding frequency. In the additional observation, the colony of *P. fungosa* in the third generation originated from aged branches changed its mode of branching and the budding frequency, and the zooecial tubes became slender.

With regard to the variation of the budding frequency, another additional observation was made using the colonies of *P. fungosa* of the 11th generation. One ancestrula was reared in a small vessels, 7.5 cm in diameter and 6 cm in height, and the other in a large vessel of 15 cm in diameter and 10 cm in height. One month later, the former became a very widely open colony in branching but its extension was smaller than the other. In this colony the zooecial tubes were slender. In the other material, the zooecial tubes were short in length and the budding frequency was larger than in the former. Between these two materials marked difference was recognized in the appearance of the colony (Pl. XVI, figs. 15, 16).

These facts prove that the appearance of the colony is easily changeable being influenced by the environmental factors. Therefore, the zoarial mass may assume various appearance under different environmental conditions.

In the growth pattern, the two species do not differ from each other under the same condition.

Measurements of the statoblasts of *P. repens* vary in wide ranges as the writer stated in 1955. At that time, the writer ascertained that the statoblasts of the material from Tsuta-numa decreased in length and width by the rearing. Measurements of the floatoblasts are as follows;

	Length (mm)	Width (mm)	Ratio
Field materials	0.409	0.306	1.32
Reared materials	0.383	0.281	1.35

The results of the rearing observations given in the present report also prove that the measurements vary in wide ranges being influenced by the environmental factors. It is certain that some field materials of the European *P. fungosa* have large sized statoblasts. But it is very difficult to say that *P. fungosa* always produces statoblasts larger than those of *P. repens*. Larger statoblasts may be

formed (1) by hereditary nature (2) by influence of the environmental factors and (3) by the combination of the two. These cannot be analysed in the field materials.

As seen in the rearing observation mentioned above, *P. fungosa* and *P. repens* sometimes showed a little difference in a few features even under the same rearing condition. The German *P. fungosa* showed a little difference from *P. repens* from Asamushi, Morigô and Yohee-numa in the appearance of the colony and in the measurements of the statoblasts, but agreed with the material from Shige-numa in all the features except for the tentacle number. In the tentacle number, *P. fungosa* differed from *P. repens* from Shige-numa but agreed with the ones from Morigô and Asamushi. The difference corresponds to that of the intraspecific groups of *P. repens*. It cannot be said that the materials which show a little difference in a few features under the same condition belong to different species. Among the different species of the Plumatellas, remarkable difference is recognized in all the features as seen in Observation 2. From these results, the German *P. fungosa* reared cannot be separated from the intraspecific groups of *P. repens*.

It seems that *P. fungosa* is a synonym of *P. repens* being an environmental variation of some intraspecific groups of *P. repens*. But it is difficult to discuss the validity of *P. fungosa* only upon the German materials. From the presence of the intraspecific groups in *P. repens*, the presence of these groups may be presumed in *P. fungosa*. To discuss the validity of *P. fungosa*, more materials of *P. fungosa* from Europe and North America should be reared.

P. fungosa changed the appearance of the colonies with the progress of generations. Therefore, comparison of the materials should be made throughout the successive generation.

SUMMARY

1. Each colony that originated from the materials of the typical *P. fungosa* from Germany was widely open in branching on a flat substratum.

2. Under the same condition, the difference among the Plumatellas is clearly seen in all the features examined.

3. The German *P. fungosa* shows a little difference from some intraspecific groups of *P. repens* in a few features.

4. This difference is not so large as among the Plumatellas, and is identical with that seen among the intraspecific groups of *P. repens*.

5. The German *P. fungosa* cannot be separated from the intraspecific groups of *P. repens*. At least, the German *P. fungosa* should be regarded as an intraspecific group of *P. repens*.

6. To discuss the validity of *P. fungosa*, more materials of this species and *P. repens* from Europe and North America should be compared with each other throughout the successive generations under the same condition.

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Explanation of Plates XI~XVIII

Plate XI

Fig. 1. One colony of *P. fungosa* reared on a flat substratum. Sept. 20th, 1957. Appearance of the colony bears a close resemblance to that of the field material of the Belgian *P. repens*. ×1.2

Fig. 2. One colony of *P. fungosa* in the 11th generation. Sept., 1970 Natural size.

Plate XII

Fig. 3. One colony of *P. emarginata* reared together with *P. repens*. Natural size.

Fig. 4. Two colonies of *P. fruticosa* Natural size.

Fig. 5. One colony of *P. vorstmani* Natural size.

Fig. 6. Two colonies of *P. casmiana* Natural size. February 15th, 1970.
In spite of that these materials were reared in one large vessel, remarkable difference is seen in the appearance of the colonies.

Plate XIII

Fig. 7. One colony of *P. repens*, Natural size

Fig. 8. One colony of *P. fungosa* Natural size February 15th, 1970
These two were reared together with the other Plumatellas in Plate XII in one large vessel. Difference is hardly seen between *P. repens* and *P. fungosa* in the appearance of the colony.

Plate XIV

Fig. 9. Two colonies of *P. repens* from Yohee-numa Natural size

Fig. 10. One colony of *P. fungosa* Natural size.

Fig. 11. One colony of *P. repens* from Aomori No. 3, Natural size. This colony resembles that of *P. fungosa* in mode of branching, but the width of zooecia is narrower than that of the latter.

Fig. 12. Two colonies of *P. repens* from Asamushi Natural size
The materials in Figs. 9–12 were reared in one large vessel. They were reared through three generations under the same condition in the laboratory. March, 1969

Plate XV

Figs. 13, 14. Young colonies of *P. fungosa* in the first generation Natural size Fig. 13. right-two colonies left-one colony Such compact colonies as these were not formed after the third generation.

Plate XVI

Fig. 15. One colony of *P. fungosa* reared in a small vessel Natural size

Fig. 16. One colony of *P. fungosa* reared in a large vessel Natural size Difference is seen in the length of zooecia and in budding frequency.

Plate XVII

Figs. 17–20. Comparison of the branches of *P. repens* and *P. fungosa* ×10
Fig. 17. *P. fungosa* The zooecial tubes are not straight and winding is seen 7th generation Fig. 18. *P. repens* from Shige-numa 2nd generation Fig. 19. *P. repens* from Yohee-numa Obscure winding is seen in the zooecial tubes. 3rd generation Fig. 20. *P. repens* from Aomori No. 3 3rd generation

Figs. 21–25. One young colony of *P. fungosa* showing its growth for five days from March 2nd to March 6th. ×10

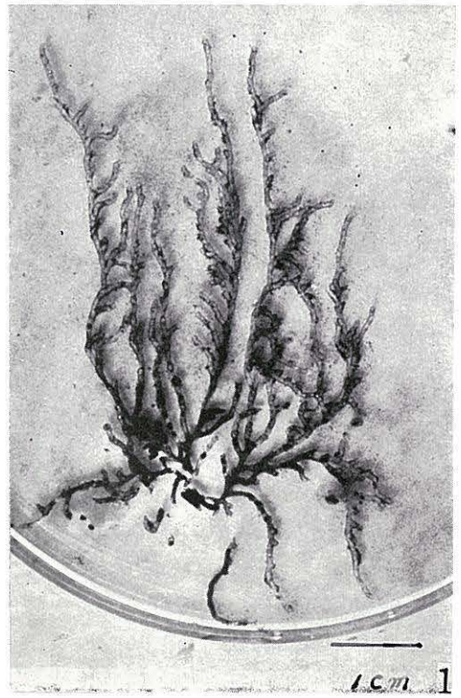
Figs. 26–30. One colony of *P. repens* from Tsuta-numa showing its growth for five days from March 2nd to March 6th 1970 ×10 Width of the zooecial tube is thicker than that of *P. fungosa*, and the growth pattern differs a little from that of *P. fungosa*.

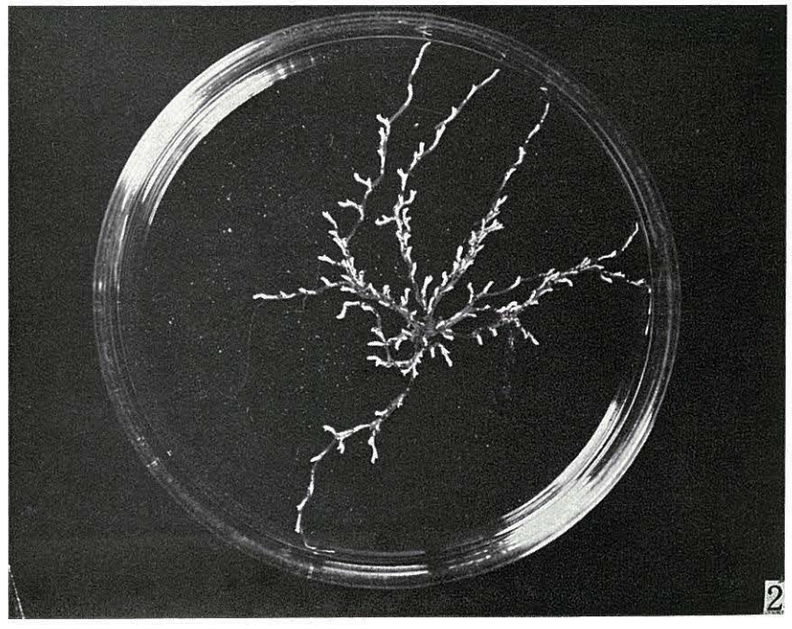
Plate XVIII

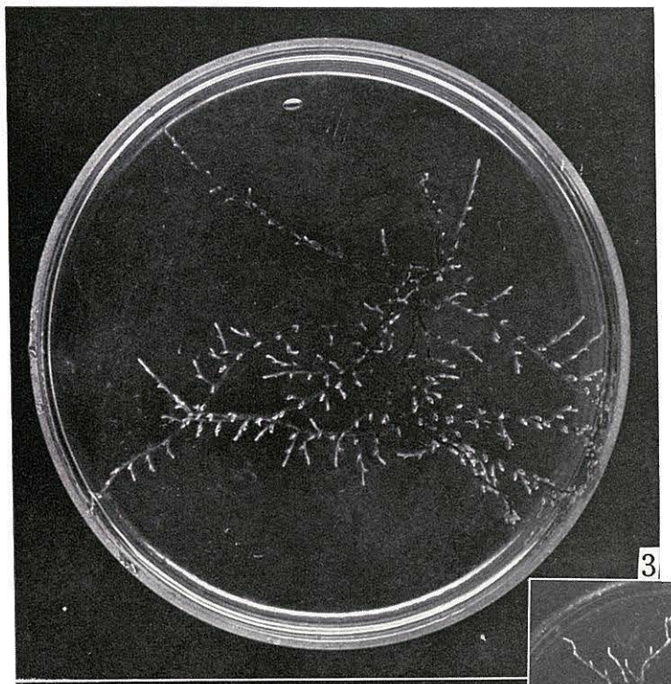
Figs. 31–36. Cross section of the tubes of *P. repens* and *P. fungosa* ×80
Figs. 31–33. *P. fungosa* in the first generation Fig. 31. Basal part of the tube at the aged central part of colony Fig. 32. ditto, at the peripheral part of the same colony Width of the tube decreased with the progress of growth. Fig. 33. *P. fungosa* in the 7th generation Sept. 3rd, 1969 Fig. 34. *P. repens* from Shige-numa in the second generation Sept. 3rd, '69 Fig. 35. *P. repens* from Morigô 2nd generation Sept. 3rd, '69 Fig. 36. *P. repens* from Tsuta-numa 5th generation Sept. 3rd, '69 These materials shown in Figs. 33–36 were reared under the same condition. Cross section was made at the third zooecial tube in a newly formed branch.

Figs. 37–42. Enlarged figures of the ectocyst of the zooecial tubes in Figs. 33–36 ×300 Thin chitinous layer is seen in the first generation of *P. fungosa*. No difference is seen in width of tubes, thickness and structure of the ectocyst between the two species.

Figs. 43–46. Floatoblasts of *P. fungosa* and *P. repens* which were reared under the same condition dorsal view ×80 Sept. 3rd, 1969.
Fig. 43. *P. fungosa* Fig. 44. *P. repens* from Shige-numa Fig. 45. *P. repens* from Tsuta-numa Fig. 46. *P. repens* from Morigô Specific difference cannot be recognized between *P. fungosa* and *P. repens* in all the features of the floatoblasts.



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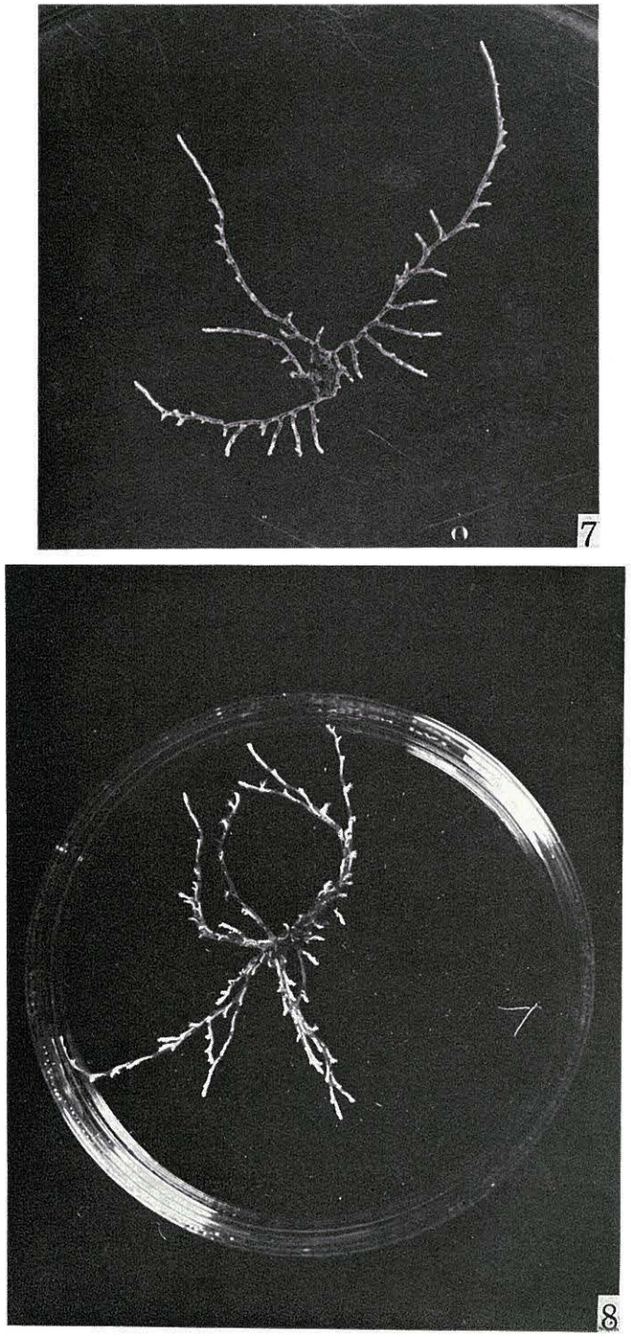
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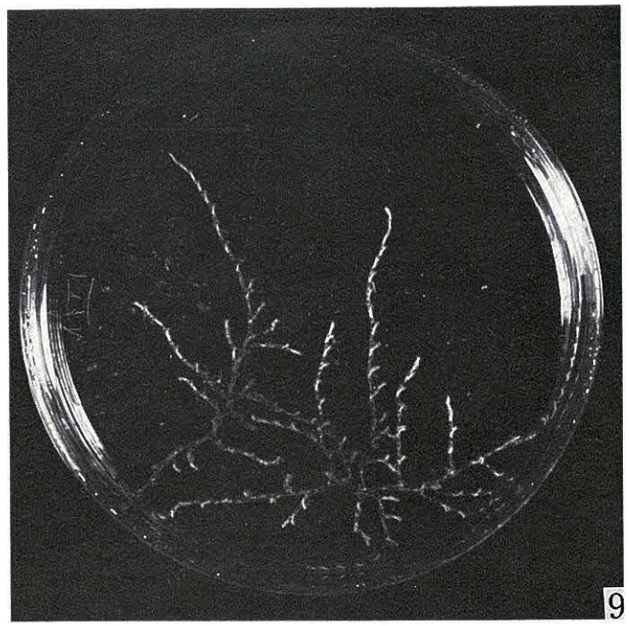
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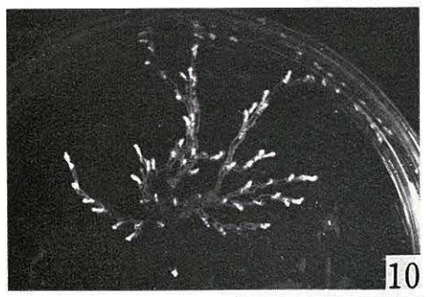
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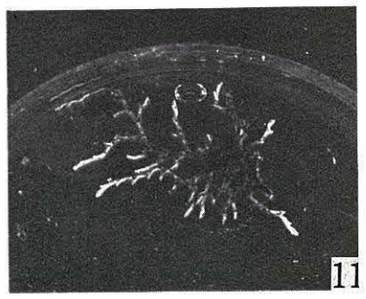
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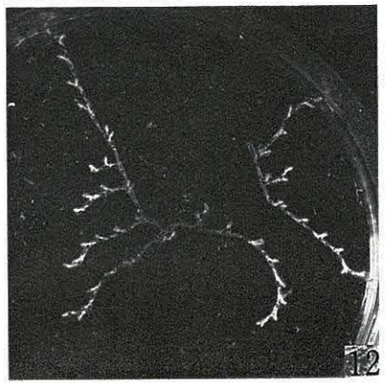
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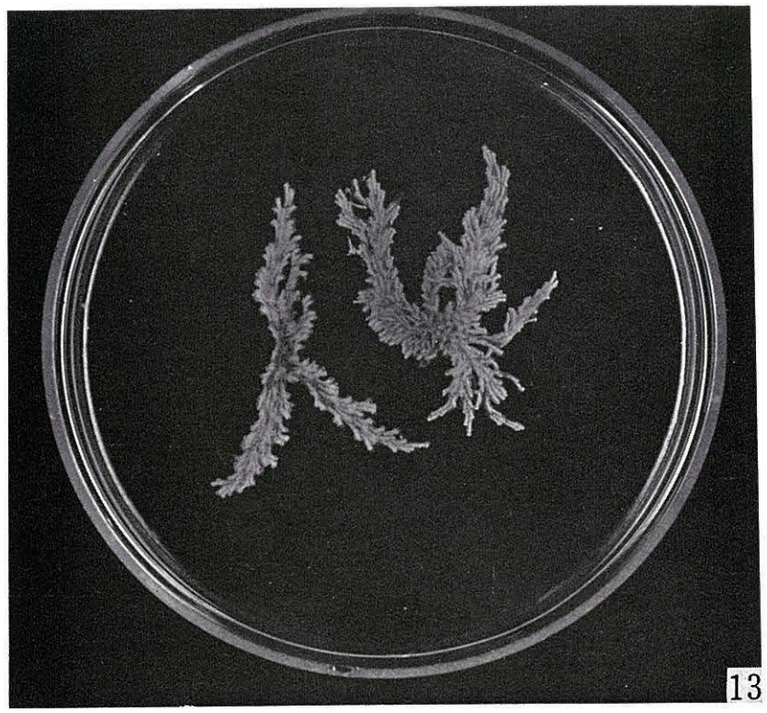
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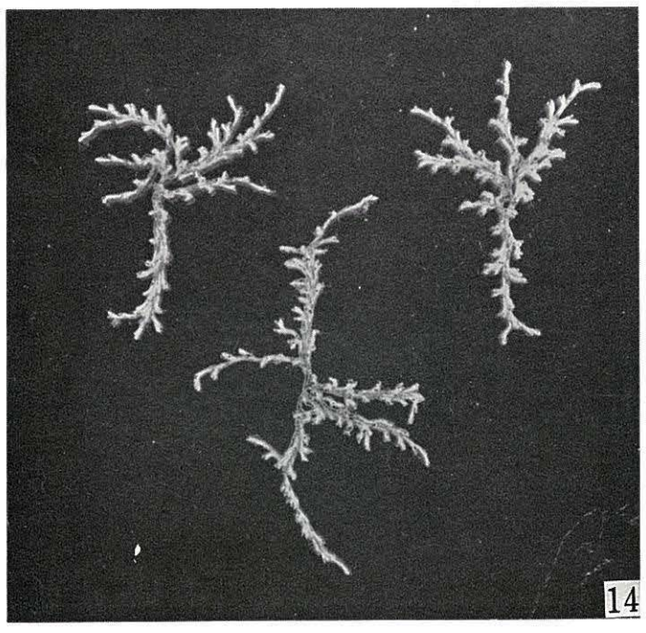
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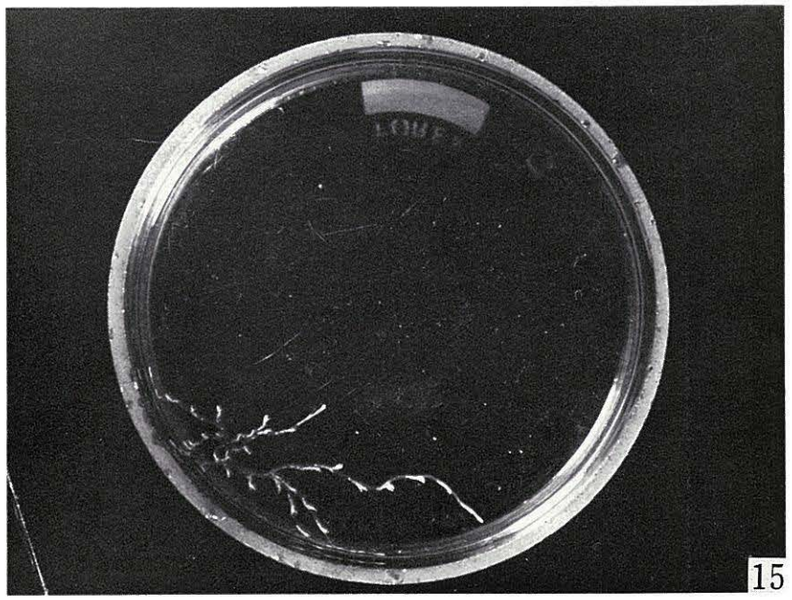

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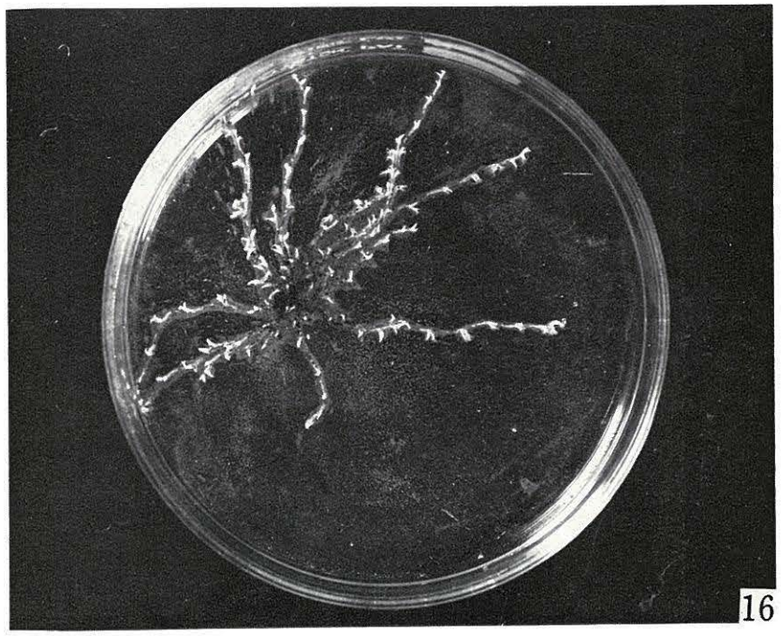

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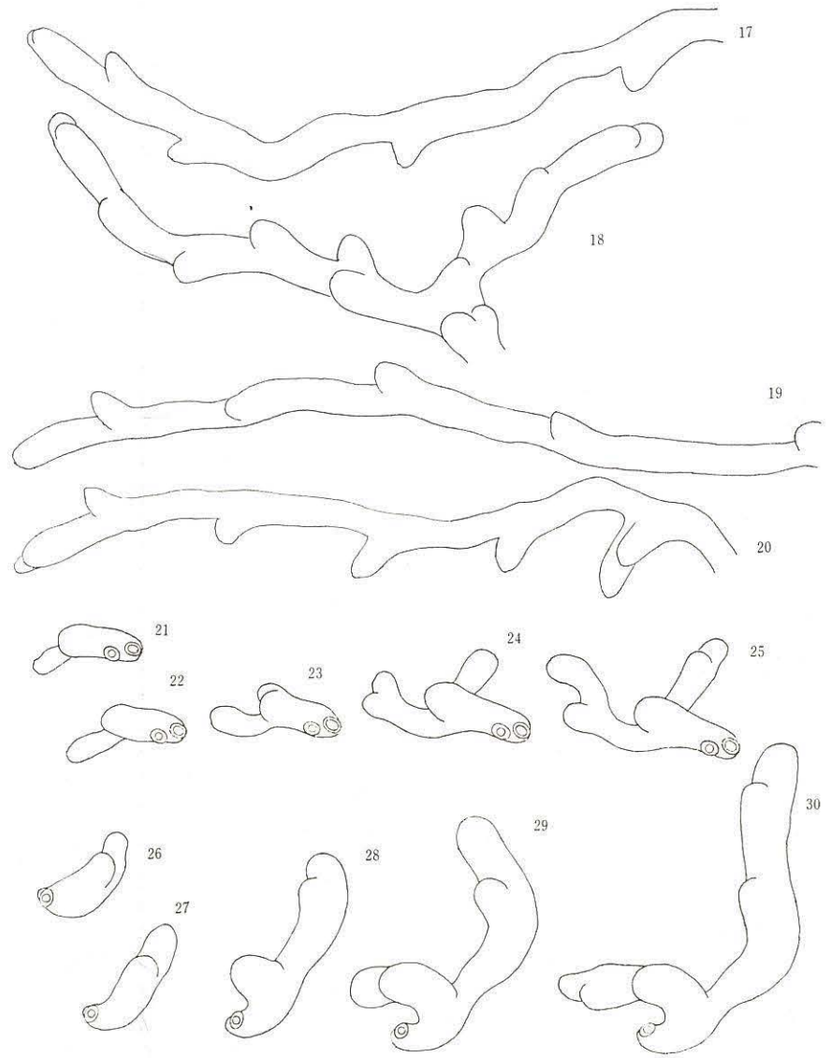

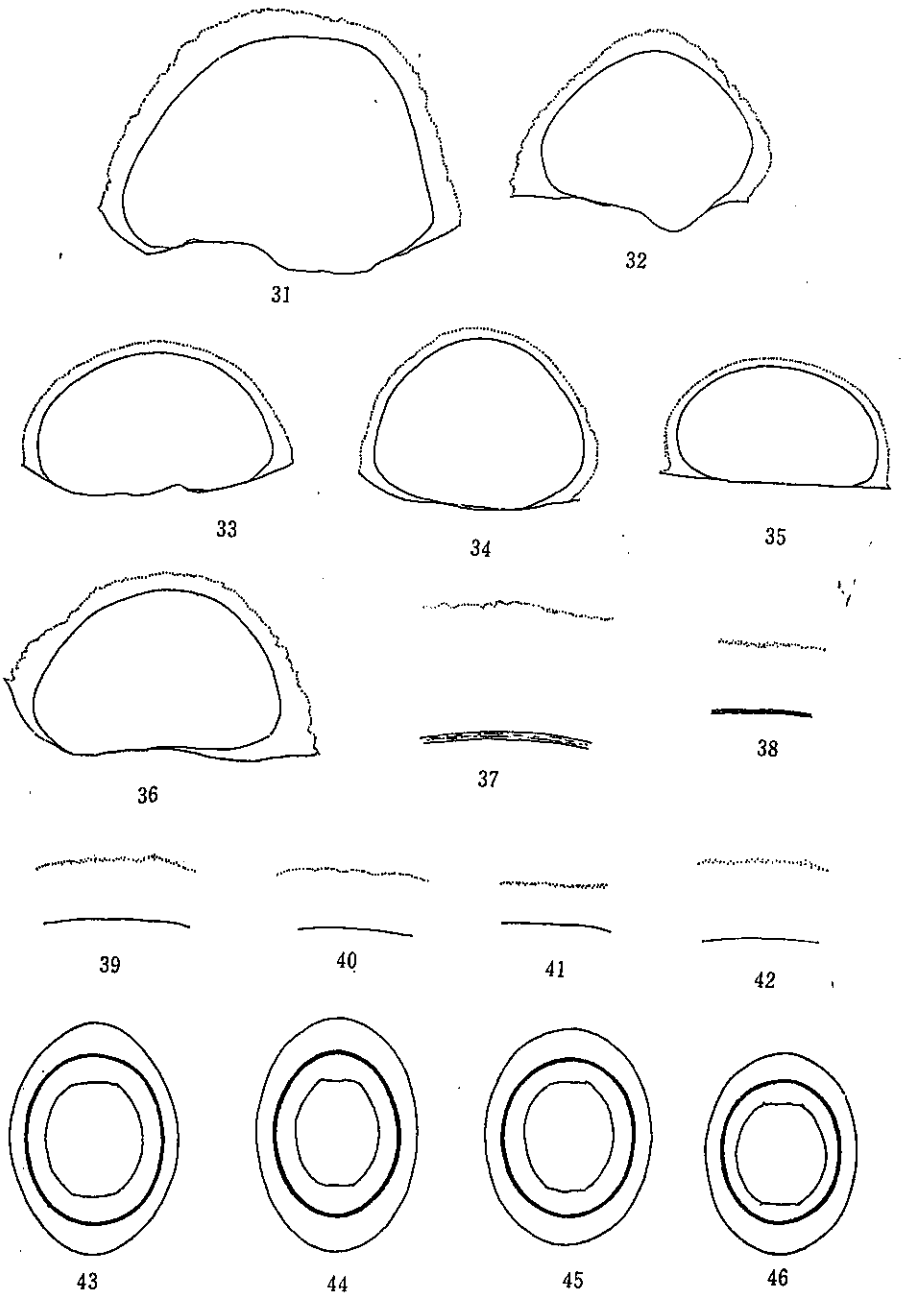
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